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Comparative Evaluation Of Postoperative Pain And Periapical Healing After Root Canal Treatment Using Three Different Base Endodontic Sealers – A Randomized Control Clinical Trial

[1]Dr. Anju S. Hussain, [*2]Swabir S.F. Tutor, [*3]Dr. Anupriya Srivastava, [*4]Dr. Maria Mathew

[1]Dr. Anju S. hussain. BDS, MDS (Endodontist). Dept of conservative dentistry and endodontics. RKDF dental college and research centre, Bhopal. anjus9645@gmail.com.

***Coauthors:**

[*2]Swabir S. F. Tutor, Dept of community health nursing, BMHRC. ICMR. swabirsf9@gmail.com.

[*3]Dr. Anupriya srivastava. Post graduate student. RKDF dental college and research centre, Bhopal. anupriyasrivastav201@gmail.com.

[*4]Dr. Maria Mathew. BDS (Dental surgeon). mariamathew10@yahoo.com

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ABSTRACT

Background: The aim of the present study was to evaluate and compare the postoperative pain and periapical healing after root canal treatment using three different base endodontic sealers. Material and Methods: Primary root canal treatment was initiated in 80 patients diagnosed with necrotic pulp and apical periodontitis, cleaning and shaping was completed in two visit and different base endodontic sealers were used for obturation were selected based on the random allocation of the participants to the following groups; Tubli-Seal, Nineteen NT apexseal, AH Plus and Maarc ceraseal B sealer. Postoperative pain was recorded by using verbal rating scale at 24 h, 48 h, 72 h and 7 d after obturation. Digital periapical radiographic evaluation was done to assess rate of periapical healing at baseline, 1, 3 and 6 months. Statistical analysis was done using Kruskal Wallis test and one-way ANOVA. Results: The mean difference in the size of periapical lesions for Tubli-Seal (3.96,7.88), Nineteen N T apexseal(6.38,10.60) AH Plus (6.34,11.99) and Maarc ceraseal B sealer (5.51,12.39) at 3 months and 6 months respectively. In Tubli-Seal group, at 24 h, 5.3% of patients showed no pain, 68.4% showed mild pain and 26.3 % showed moderate pain; at 48 h, 84.2% of patients showed no pain, 10.5% showed mild pain and 5.3 % showed moderate pain; At 72 h, 84.2% of patients showed no pain, 10.5% showed mild pain and 5.3 % showed moderate pain; At 7 d, none of the patients reported with pain. Conclusions: Maarc Cera Seal B sealer showed less postoperative pain compared to AH Plus, Nineteen NT and Tubli-Seal and showed better periapical healing compared to AH Plus and Tubli-Seal at 3 and 6 months intervals respectively

INTRODUCTION

Periapical lesions result from an inflammatory response to microbes around the tooth root, typically stemming from infections in the root canal system. This condition often arises due to trauma, caries, or tooth wear, leading to chronic inflammation and loss of blood supply in the pulp tissue, which can be colonized by microorganisms. Proper diagnosis and assessment of periapical lesions are crucial before starting endodontic therapy, which aims to minimize bacterial presence and resolve the lesion.

Radiographic evaluations, such as the Periapical Index (PAI), help assess periapical inflammation and evaluate the effectiveness of endodontic treatments. Successful treatment relies on precise instrumentation, thorough disinfection, and effective obturation, with a focus on creating a hermetic seal to prevent recurrence of bacterial growth. The choice of sealer plays a significant role, as different sealers exhibit varying biological, physical, and chemical properties affecting treatment outcomes.

Postoperative pain is a common complication after endodontic procedures, affecting between 3% to 58% of patients, depending on individual circumstances. This pain can stem from mechanical, chemical, or microbiological injuries to periradicular tissues. Clinicians must understand the factors related to postoperative pain, including the type of endodontic sealer used, to enhance treatment strategies and outcomes.

Traditionally, root canal systems utilize gutta-percha combined with sealers, which may inadvertently contact periapical tissues through lateral canals or apical foramina. Research indicates that these sealers can lead to inflammatory responses and pain symptoms by activating sensory neurons in the affected area. Studies show mixed results regarding postoperative pain associated with various sealers. For instance, research comparing resin-based and calcium silicate-based sealers found no significant differences in pain levels, while other studies showed that specific resin-based sealers exhibited different pain outcomes compared to calcium hydroxide-based sealers.

The inflammatory responses elicited by certain sealers, particularly those containing calcium hydroxide, have been linked to improved healing outcomes, as they promote the differentiation of macrophages and giant cells. Studies have indicated that sealers like Sealapex may promote better tissue responses and mineralized tissue deposition, thus enhancing healing capabilities even when extruded beyond the apex.

Several factors complicate the evaluation of periapical lesion healing, such as incomplete bacterial removal from complex root canal structures and the extrusion of infected debris during treatment. Various types of endodontic sealers, including zinc oxide-eugenol, resin-based, and calcium hydroxide-based options, are employed in clinical practice, with recent advances in bioactive materials demonstrating promise for improving healing rates.

The current research aims to assess the incidence and intensity of postoperative pain and the healing of periapical lesions after root canal treatments using four distinct sealers: a zinc oxide-eugenol sealer, a calcium hydroxide-based sealer, a resin-based sealer (AH Plus), and an MTA-based sealer. This study involves patients diagnosed with necrotic pulp and apical periodontitis, aiming to provide insights into how different sealers may influence treatment outcomes and patient experiences post-treatment. Understanding these dynamics will contribute to refining endodontic practices and patient care.

AIMS AND OBJECTIVES

AIM OF THE STUDY

To evaluate and compare postoperative pain and periapical healing after root canal treatment using three different types of endodontic sealers: zinc oxide-eugenol-based, calcium hydroxide-based, and resin-based sealers.

OBJECTIVES OF THE STUDY:

- To evaluate and compare the postoperative pain and periapical healing after root canal treatment using a zinc oxide eugenol-based sealer, Tubli-Seal (Control group).
- To assess postoperative pain and periapical healing after root canal treatment using a calcium hydroxide-based sealer, Nineteen NT Apex Seal.
- To examine postoperative pain and periapical healing after root canal treatment with a resin-based sealer, AH Plus.
- To analyze postoperative pain and periapical healing after root canal treatment with an MTA-based root canal sealer, Maarc Cera Seal-B.
- To comparatively evaluate the postoperative pain and periapical healing among all these endodontic sealers, with a focus on comparing each sealer to the control group.

MATERIALS AND METHODS

Method

The study was designed as a double-blinded clinical trial conducted according to the CONSORT (Consolidated Standards of Reporting Trials) guidelines. The trial occurred in the department of Conservative Dentistry and Endodontics at RKDF Dental College and Research Centre in Bhopal, Madhya Pradesh.

Ethical Approval and Sample Size Modulation

The study obtained ethical clearance from the ethical committee of Sarvepalli Radha Krishnan University, Bhopal (RKDF/DC/PG/2022/17686). A total of 80 patients were selected for the study after providing informed consent following a clear explanation of the study's purpose and procedures.

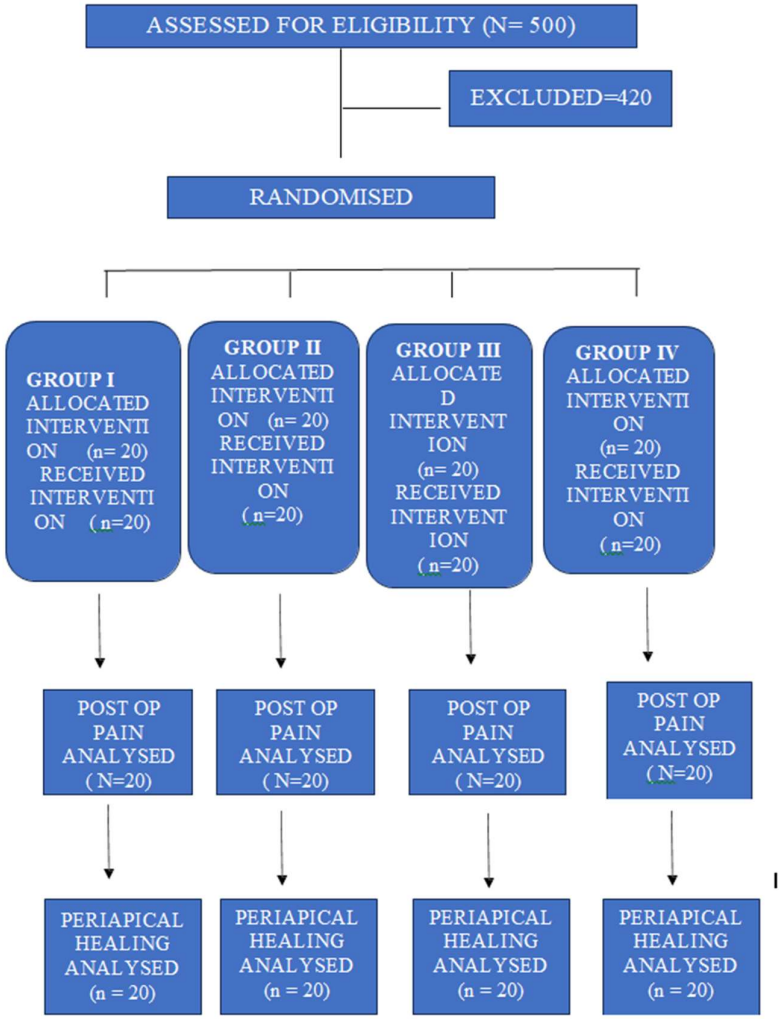
Sample Size Calculation

Sample size was calculated prior to the study using G*Power 3.2.1 software based on a previously published study. Employing a one-way ANOVA fixed effects model with an alpha of 0.05, beta of 0.95, and an effect size of 0.05, it was determined that 20 patients per group would be sufficient.

Sample Recruitment

Over six months, 500 patients were screened for eligibility. Out of these, 403 patients did not meet the inclusion criteria, while 17 were excluded for specific reasons, including one pregnant patient, five with diabetes mellitus, and 11 who declined participation. Ultimately, 80 patients met the eligibility criteria and consented to participate, as illustrated in the CONSORT flowchart (Fig. 1).

Fig. 1: CONSORT flowchart illustrating the study design, including an overview of the various treatment protocols, patient attrition during follow-up, and periapical healing analysis



Inclusion Criteria:

- Patients aged 18-60 undergoing endodontic therapy for maxillary or mandibular anterior teeth.
- Diagnosis of necrotic pulp with chronic apical periodontitis confirmed by a sensibility test and a periapical index (PAI) score of 2 or higher, as determined by digital radiography.

Exclusion Criteria

- Immature permanent teeth.
- Teeth with endodontic-periodontic lesions.
- Presence of dystrophic calcifications or root curvature greater than 20º.
- Pregnant or lactating women.
- Root fractures.
- Patients who took analgesics within 12-24 hours before treatment.

Randomization

Randomization was carried out using a computer-generated random number table obtained from an online service (random.org). Two experienced endodontists not involved in treatment assessed the periapical radiographs and reached a consensus on lesion size. In disagreement cases, a third senior specialist was consulted. Randomization results, including group numbers and treatment protocols, were recorded and sealed in dark envelopes, which were opened only after assigning the interventions.

Sampling of Study Groups

The 80 eligible patients were divided into four groups based on the type of endodontic sealer used:

1. Group 1: Zinc oxide-eugenol (Tubli-Seal)
2. Group 2: Calcium hydroxide-based (Nineteen NT Apex Seal)
3. Group 3: Epoxy-resin-based (AH Plus)
4. Group 4: Bioceramic-based (Maarc CeraSeal B)

Treatment Procedure

On the first appointment day, local anesthesia was administered, and a rubber dam was applied for isolation. A digital radiographic evaluation was performed with a customized grid using a paralleling technique. After caries excavation and access cavity preparation utilizing the Endo Access Kit, the pulp chamber contents were debrided. Initial patency was confirmed using an ISO size 10 K-File and working length was recorded with an electronic apex locator.

The canals were prepared using the Protaper Gold rotary system. NaOCl (3%) was used for each cycle and canal patency maintained with an ISO 15 K-File. The smear layer was effectively removed with EDTA (17%), followed by a final irrigation of NaOCl and saline. Sonic activation was employed for 60 seconds during each irrigation cycle.

Following biomechanical preparation, canals were dried and filled with a freshly mixed calcium hydroxide paste. A temporary seal was applied using intermediate restorative cement. Patients were recalled after one week for further assessment.

Recall After One Week

Asymptomatic patients who achieved a Visual Analog Scale (VAS) Score of 0 with dry canals were proceeded to the next treatment phase, where obturation was performed according to randomized group assignments.

Sealer Application and Obturations

Following manufacturer instructions, the sealer was mixed on a sterile glass slab, and the apical extent of the master cone was confirmed radiographically. Canals were dried with sterile paper points, and the sealer was applied using a lentulospiral. The lateral compaction technique was employed for obturation, and a 1 mm occlusal reduction was performed on treated teeth for permanent restoration with composite resin.

Periapical Healing Assessment

Digital radiographs were obtained after obturation to establish baseline data. Two experienced endodontists analyzed data independently to ensure high interobserver agreement, evidenced by a Cohen's kappa of 0.90 ($p < 0.05$) for periapical diagnosis. The sealer extrusion's presence was also recorded.

Periapical Lesion Size Calculation

The lesions were calculated by marking their boundaries and employing the formula: AREA = ½ base X perpendicular height (½ BH) using a grid X-ray mesh gauge for accuracy. Follow-up radiographs were taken at 1, 3, and 6 months to evaluate size changes.

Post-Treatment Pain Reduction Assessment

Patients recorded their pain scores at 24, 48, 72 hours, and 7 days post-treatment. Telephone follow-ups confirmed scores and recorded analgesic usage. Pain was assessed using a verbal rating scale (VRS), where patients rated their pain on a scale of 0 (normal) to 5 (severe pain).

This rigorous methodology ensured reliable data collection, allowing for an in-depth analysis of both periapical healing and postoperative pain associated with different endodontic sealers.

STATISTICAL ANALYSIS

Data were entered into a Microsoft Excel spreadsheet and analyzed using SPSS software (ver. 22, IBM Corporation, Armonk, USA). Normality tests, including the Kolmogorov-Smirnov and Shapiro-Wilk tests, indicated that the variables did not follow a normal distribution. Consequently, non-parametric tests were employed for data analysis.

RESULTS

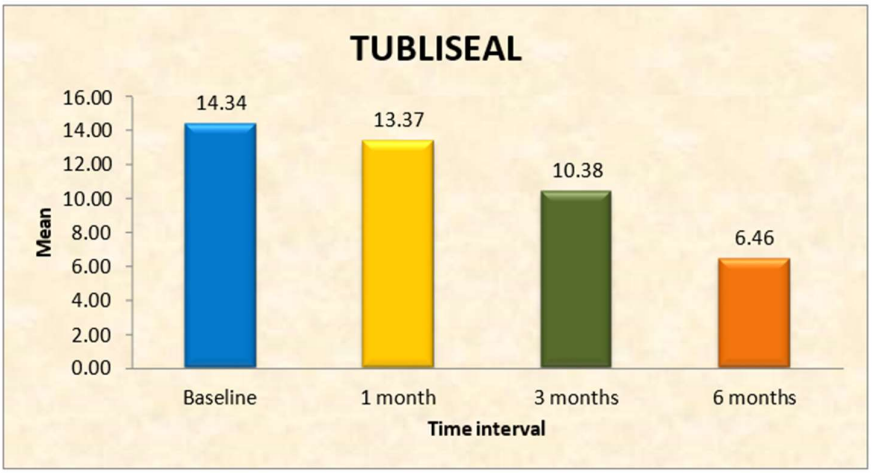
A total of 80 patients participated in the study, comprising 31 males and 49 females. No significant differences in gender distribution were observed among the groups.

Table 2: shows the gender distribution among the groups.

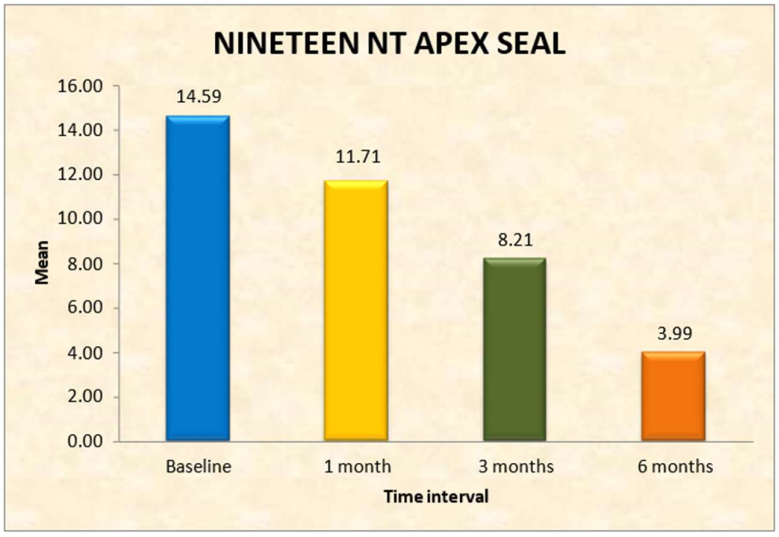
TABLE 2: GENDER DISTRIBUTION AMOUNG GROUPS		
GROUP	MALES, n%	FEMALES, n %
GROUP I	45	55
GROUP II	40	60
GROUP III	30	70
GROUP IV	40	60

In group I, 45% of the samples were males while 55% of the samples were females; group II, 40% males and 60% females; group III, 30% males and 70% females and group IV, 40% males and 60% were females. [Table1].

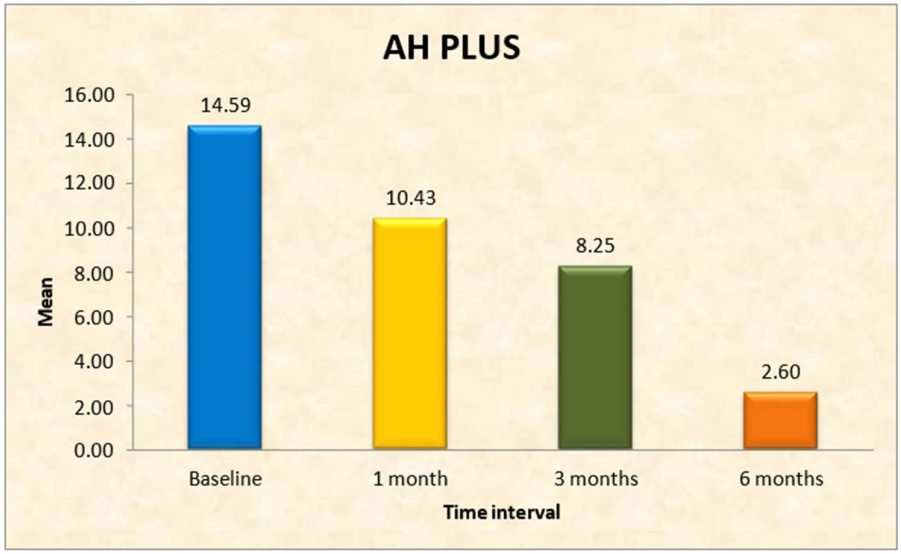
Graph 1: Mean size of the periapical healing at different time interval in group I (Tubliseal)



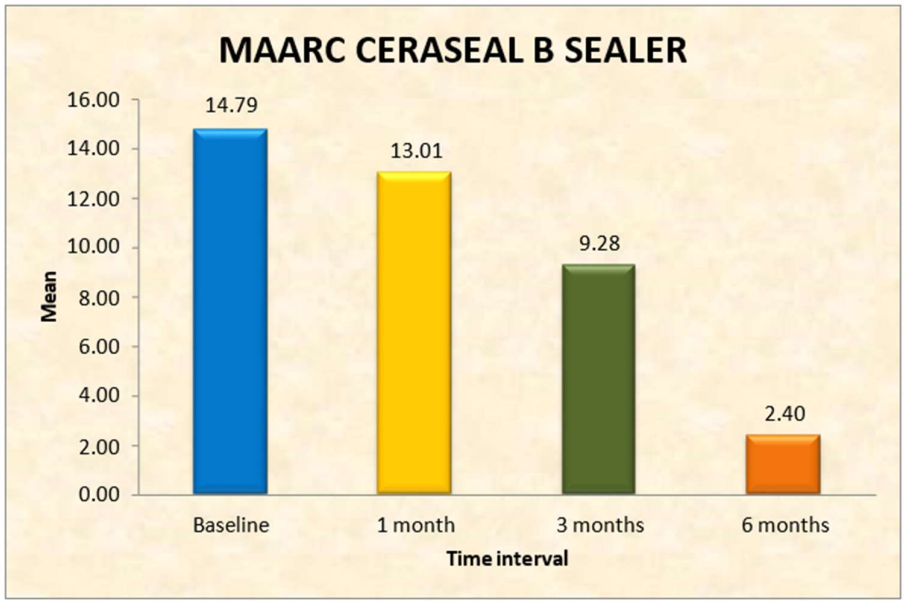
Graph 2 : Mean size of the periapical healing at different time interval in group II (Nineteen NT Apexseal)



Graph 3: Mean size of the periapical healing at different time interval in group III (AH Plus)



Graph 4: Mean size of the periapical healing at different time interval in group IV (Maarc Cera seal B sealer)



Graph 1– 4 illustrate the mean size of the periapical healing at different time intervals of group I, group II, group III and group IV respectively

TABLE 3: Mean size of the periapical lesion (in mm sq.) was assessed for different study groups at various time intervals (Baseline, 1 month, 3 month and 6 month)

GROUP	Time interval	N	Mean	SD	Chi-square value	P value
GROUP I (TUBLISEAL)	Baseline	20	14.34	0.70	60.000	0.000 S
	1 month	20	13.37	0.57		
	3 months	20	10.38	0.56		
	6 months	20	6.46	0.36		
GROUP II (NINETEEN NT APEX SEAL)	Baseline	20	14.59	0.65	60.000	0.000 S
	1 month	20	11.71	0.53		
	3 months	20	8.21	0.41		
	6 months	20	3.99	0.56		
GROUP III (AH PLUS)	Baseline	20	14.59	0.40	60.000	0.000 S
	1 month	20	10.43	0.46		
	3 months	20	8.25	0.44		
	6 months	20	2.60	0.31		
GROUP IV (MAARC CERASEAL B SEALER)	Baseline	20	14.79	0.43	60.000	0.000 S
	1 month	20	13.01	0.71		
	3 months	20	9.28	0.39		
	6 months	20	2.40	0.37		

Statistical analysis: Friedman's test. S: Statistically significant if P<0.05; NS: Not significant.

Table 3 denotes the difference in the mean area of the periapical lesion from baseline to 6 months, there was no difference in the mean area of the periapical lesion at baseline interval, and reduction of size of lesion was seen at 3 and 6 months for all the test groups (p=0.001).

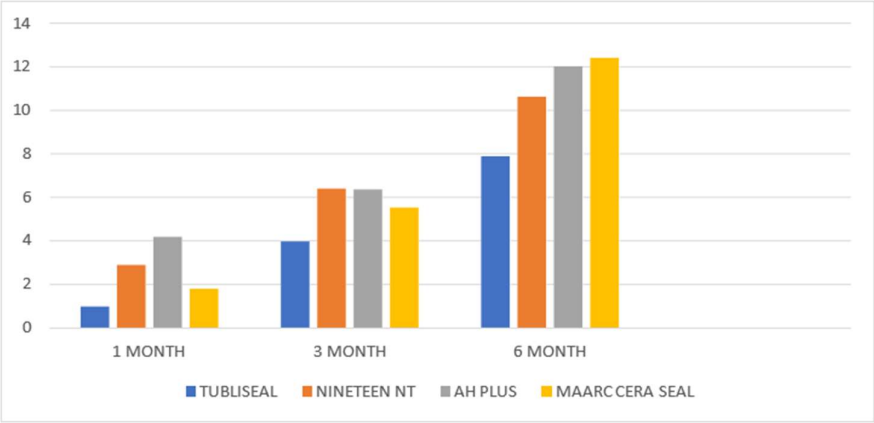
TABLE 4: Mean comparison of periapical healing of intra groups at different time intervals ie.Baseline, 1 month, 3 month, 6 month (From baseline to different follow- ups.within the group)

Group	Time interval	N	Mean	SD	Mean difference from Baseline	Z value	P value
Group I TUBLISEAL	Baseline	20	14.34	0.70	--	--	--
	1 month	20	13.37	0.57	0.97	3.922	0.000 S
	3 months	20	10.38	0.56	3.96	3.921	0.000 S
	6 months	20	6.46	0.36	7.88	3.92	0.000 S
Group II NINETEEN NT APEX SEAL	Baseline	20	14.59	0.65	--	--	--
	1 month	20	11.71	0.53	2.88	3.920	0.000 S
	3 months	20	8.21	0.41	6.38	3.920	0.000 S
	6 months	20	3.99	0.56	10.60	3.920	0.000 S
Group III AH PLUS	Baseline	20	14.59	0.40	--	--	--
	1 month	20	10.43	0.46	4.16	3.921	0.000 S
	3 months	20	8.25	0.44	6.34	3.920	0.000 S
	6 months	20	2.60	0.31	11.99	3.920	0.000 S
Group IV MAARC CERASEAL B SEALER	Baseline	20	14.79	0.43	--	--	--
	1 month	20	13.01	0.71	1.78	3.920	0.000 S
	3 months	20	9.28	0.39	5.51	3.920	0.000 S
	6 months	20	2.40	0.37	12.39	3.920	0.000 S

Statistical analysis: Wilcoxon signed ranks test. S: Statistically significant if P<0.05; NS: Not significant.

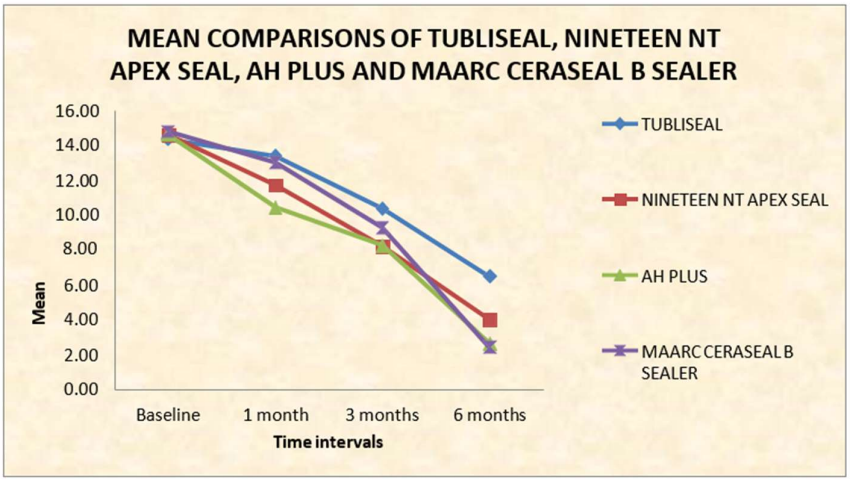
Table 4 demonstrates that periapical healing rate was clearly visible at 6 months. At 1 month periapical healing was negligible when compared to the baseline data. Maarc ceraseal B sealer is showing maximum perapical healing rates at 6 months followed by AH plus, Nineteen NT apexseal and tubliseal. At 3 months periapical healing rates are almost similar with AH plus and Ninteen NT apexseal.

GRAPH 5: Mean Comparisons Of Tubliseal, Nineteen NT Apex Seal, AH Plus And Maarc Ceraseal B Sealer from Baseline to Different Follow-Up

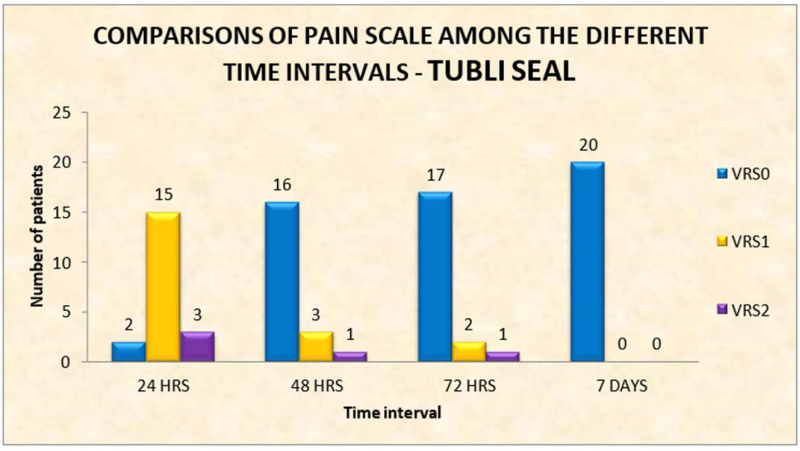


From this graph it has been concluded that at 1 month maximal periapical healing was given by AH Plus followed by Nineteen NT Apex seal, Maarc cera seal sealer and Tubliseal. At 3 months periapical healing rates was almost similar with nineteen NT and AH plus.

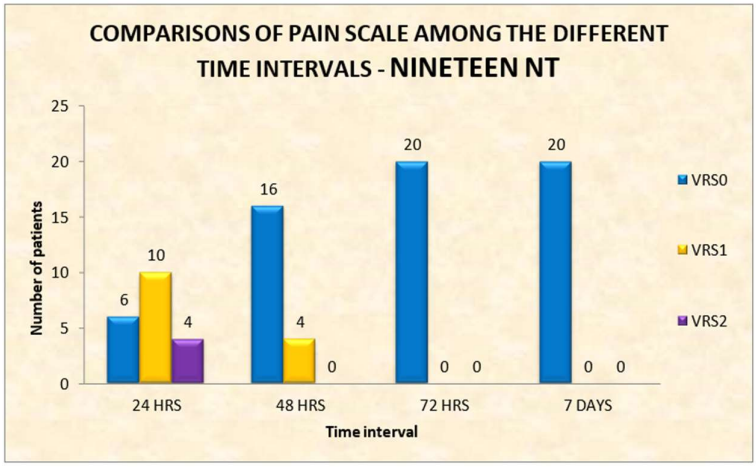
GRAPH 6: The mean periapical healing scores were evaluated at different time interval



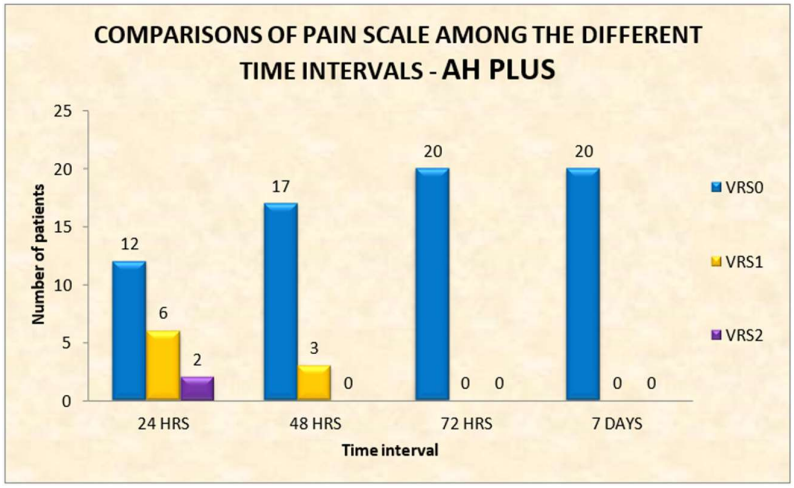
GRAPH 7: Graph depicting comparison of pain scale VRS scores of Group I(Tubliseal) at different time interval



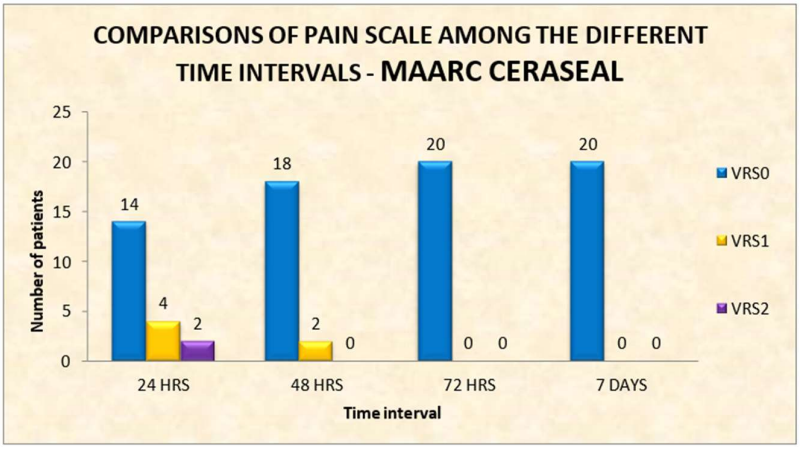
GRAPH 8: Graph depicting comparison of pain scale VRS scores of Group II(Nineteen NT apexseal) at different time interval



GRAPH 9: Graph depicting comparison of pain scale VRS scores of Group III (AH Plus) at different time interval



GRAPH 10: Graph depicting comparison of pain scale VRS scores of Group IV (Maarc ceraseal B) at different time interval



Pain Assessment Results:

- **Tubli-Seal Group:**
  - **24 Hours:** 5.3% of patients reported no pain, 68.4% reported mild pain, and 26.3% reported moderate pain.
  - **48 Hours:** 84.2% of patients reported no pain, 10.5% reported mild pain, and 5.3% reported moderate pain.
  - **72 Hours:** 84.2% of patients reported no pain, 10.5% reported mild pain, and 5.3% reported moderate pain.
  - **7 Days:** No patients reported pain.
- **Nineteen NT Apexseal Group:**
  - **24 Hours:** 44.5% of patients reported no pain, and 40% reported mild pain.
- **AH Plus Group:**
  - **24 Hours:** 31.8% of patients reported no pain, 50% reported mild pain, and 18.2% reported moderate pain.
  - **48 Hours:** 81.8% of patients reported no pain, and 18.2% reported mild pain.
  - **72 Hours:** No patients reported pain.
  - **7 Days:** No patients reported pain.
- **Maarc Ceraseal B Sealer Group:**
  - **24 Hours:** 68.4% of patients reported no pain, 15.8% reported mild pain, and 15.8% reported moderate pain.
  - **48 Hours:** 85% of patients reported no pain, and 15% reported mild pain.
  - **72 Hours:** No patients reported pain.
  - **7 Days:** No patients reported pain.

Table 5: Comparisons of Pain Scale among the different time interval. Statistical analysis: Chi-square test. S: Statisti.

GROUP	TIME	NUMBER OF PATIENTS			Total	Chi-square value	P value
		VRS0	VRS1	VRS2			
		n (%)	n (%)	n (%)	n (%)		
Group I TUBLI SEAL	24 HRS	2 (10%)	15 (75%)	3 (15%)	20 (100%)	45.418	0.000 S
	48 HRS	16 (80%)	3 (15%)	1 (5%)	20 (100%)		
	72 HRS	17 (85%)	2 (10%)	1 (5%)	20 (100%)		
	7 DAYS	20 (100%)	0 (0%)	0 (0%)	20 (100%)		

Group II NINETEEN NT	24 HR	6 (30%)	10 (50%)	4 (20%)	20 (100%)	39.594	0.000 S
	48 HR	16 (80%)	4 (20%)	0 (0%)	20 (100%)		
	72 HR	20 (100%)	0 (0%)	0 (0%)	20 (100%)		
	7 DAYS	20 (100%)	0 (0%)	0 (0%)	20 (100%)		
Group III AH PLUS	24 HR	12 (60%)	6 (30%)	2 (10%)	20 (100%)	19.478	0.000 S
	48 HR	17 (85%)	3 (15%)	0 (0%)	20 (100%)		
	72 HR	20 (100%)	0 (0%)	0 (0%)	20 (100%)		
	7 DAYS	20 (100%)	0 (0%)	0 (0%)	20 (100%)		
Group IV MAARC CERASEAL	24 HR	14 (70%)	4 (20%)	2 (10%)	20 (100%)	14.667	0.023 S
	48HR	18 (90%)	2 (10%)	0 (0%)	20 (100%)		
	72 HR	20 (100%)	0 (0%)	0 (0%)	20 (100%)		
	7 DAYS	20 (100%)	0 (0%)	0 (0%)	20 (100%)		

On analysing the data, the results showed that at 24 hours on using different sealers, VRS 0 scores was exhibited by 70% of the group IV population, whereas only 10% of the group I population showed VRS 0 scores. This indicates that endodontic treatment using bioceramic sealers illustrates minimal incidence of postoperative pain at 24 hours while in Group I only 10% of the patients showed zero pain values at 24 hours. In group II, III, and IV exhibits zero VRS scores at 72 hours. None of the patients had pain at 7 days.

INTER-GROUP COMPARISONS

TABLE 6: INTER-GROUP COMPARISONS OF MEAN SCORES OF TUBLISEAL, NINETEEN NT APEX SEAL, AH PLUS AND MAARC CERASEAL.

Time	Groups	N	Mean	SD	Chi-square value	P value
Baseline	TUBLISEAL	20	14.34	0.70	3.956	0.266 NS
	NINETEEN NT APEX SEAL	20	14.59	0.65		
	AH PLUS	20	14.59	0.40		
	MAARC CERASEAL B SEALER	20	14.79	0.43		
1 month	TUBLISEAL	20	13.37	0.57	60.798	0.000 S
	NINETEEN NT APEX SEAL	20	11.71	0.53		
	AH PLUS	20	10.43	0.46		
	MAARC CERASEAL B SEALER	20	13.01	0.71		
3 months	TUBLISEAL	20	10.38	0.56	61.143	0.000 S
	NINETEEN NT APEX SEAL	20	8.21	0.41		
	AH PLUS	20	8.25	0.44		
	MAARC CERASEAL B SEALER	20	9.28	0.39		
6 months	TUBLISEAL	20	6.46	0.36	67.361	0.000 S
	NINETEEN NT APEX SEAL	20	3.99	0.56		
	AH PLUS	20	2.60	0.31		
	MAARC CERASEAL B SEALER	20	2.40	0.37		

Statistical analysis: Kruskal-Wallis test. S: Statistically significant if P<0.05; NS: Not significant.

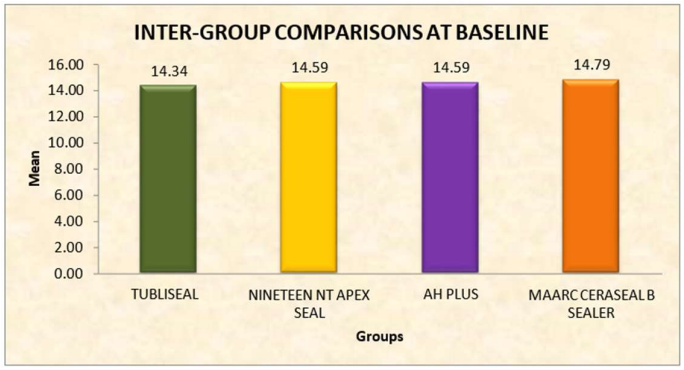
TABLE 7: INTER-GROUP COMPARISONS OF MEAN SCORES OF TUBLISEAL, NINETEEN NT APEX SEAL, AH PLUS AND MAARC CERASEAL.

GROUPS	Baseline		1 month		3 months		6 months	
	Mean diff	P value	Mean diff	P value	Mean diff	P value	Mean diff	P value
TUBLISEAL Vs NINETEEN NT APEX SEAL	0.25	0.285 NS	1.66	0.000 S	2.17	0.000 S	2.47	0.000 S
TUBLISEAL Vs AH PLUS	0.25	0.297 NS	2.94	0.000 S	2.13	0.000 S	3.86	0.000 S
TUBLISEAL Vs MAARC CERASEAL B SEALER	0.45	0.055 NS	0.36	0.113 NS	1.10	0.000 S	4.06	0.000 S
NINETEEN NT APEX SEAL Vs	0.00	0.829	1.28	0.000	0.04	0.808	1.39	0.000
AH PLUS		NS		S		NS		S
NINETEEN NT APEX SEAL Vs MAARC CERASEAL B SEALER	0.20	0.394 NS	1.30	0.000 S	1.07	0.000 S	1.59	0.000 S
AH PLUS Vs MAARC CERASEAL B SEALER	0.20	0.285 NS	2.58	0.000 S	1.03	0.000 S	0.20	0.091 NS

Statistical analysis: Mann-Whitney U test. S: Statistically significant if P<0.05; NS: Not significant.

On comparing the tubliseal and nineteen nt apexseal study group, the mean difference was noted as 0.25,1.66, 2.17, and 2.47 at baseline, 1 month, 3 month and 6 month respectively. When comparing tubliseal with nineteen NT apexseal the mean difference in periapical healing was noted as 2.47 at 6 months. Eventhough AH Plus and Maarc Cera seal B sealer showing similar results in periapical healing mean difference was noted as 0.20, 1.03, 2.58 at 6 months, 3 months and 1 month respectively.

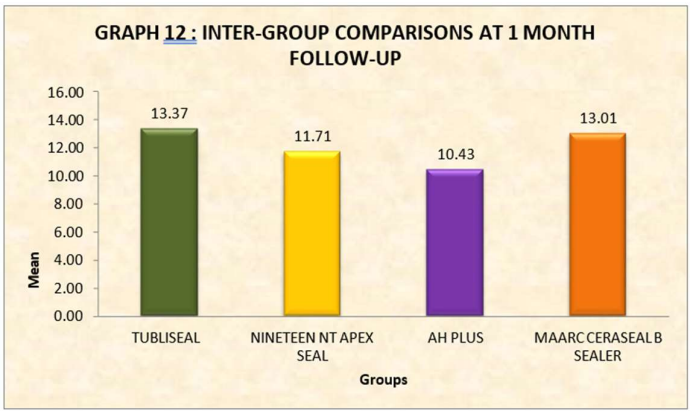
GRAPH 11: intergroup comparison at baseline



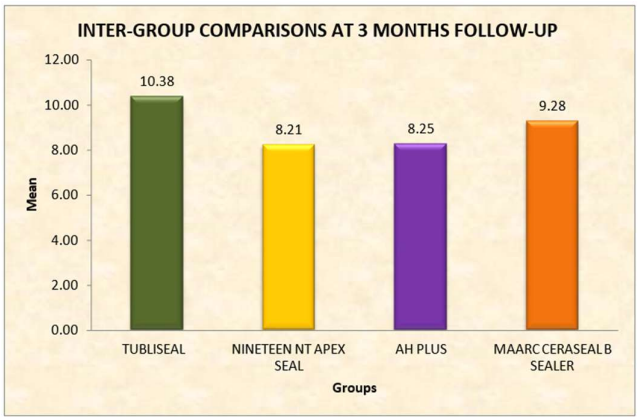
From these graphs it is clear that at baseline all the sealer groups are showing comparable results at baseline. At 1 month AH plus sealer group is showing maximal reduction periapical lesion size , while minimal reduction is showing by tubliseal followed by Maarc

cera seal B sealer and nineteen NT.

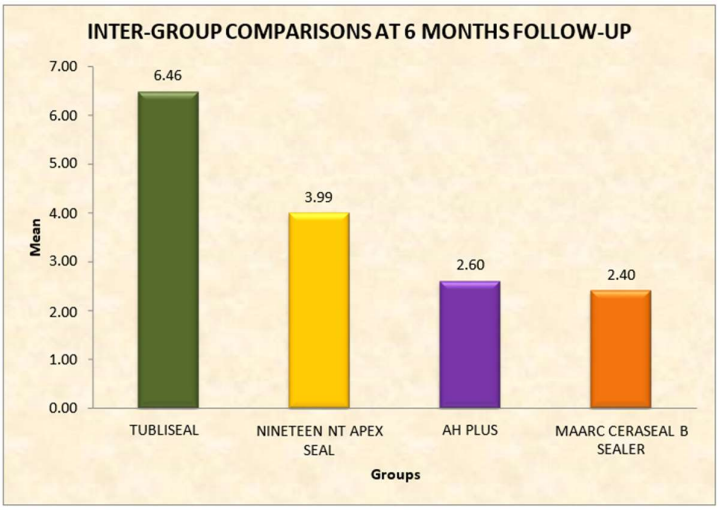
GRAPH 12: Intergroup comparison at 1 month follow up



GRAPH 13: Intergroup comparison at 3 months follow up



GRAPH 14 : Inter group comparisons at 6 months follow up



- **Summary of Findings:**
- **Gender Distribution:** No significant difference was observed between gender distributions across the groups (Table 2).
- **Periapical Healing:**
- All groups showed significant periapical healing at 1, 3, and 6 months.
- **Maarc Ceraseal B Sealer** demonstrated the most substantial healing, followed by **AH Plus, Nineteen NT Apexseal, and Tubli-Seal** (Tables 3 and 4).
- Postoperative Pain:
- The severity and incidence of postoperative pain decreased steadily over time.
- **Maarc Ceraseal B Sealer** resulted in the least postoperative pain, with **AH Plus, Nineteen NT Apexseal,** and **Tubli-Seal** following (Table 5).
- By 72 hours, no pain was reported in Groups II (AH Plus), III (Nineteen NT Apexseal), and IV (Maarc Ceraseal B Sealer).
- At 48 hours, 80% of patients in Groups I (Tubli-Seal) and II (AH Plus) and 85% in Group III (Nineteen NT Apexseal) reported VRS 0, with 90% in Group IV (Maarc Ceraseal B Sealer).
- At 7 days, no postoperative pain was reported in any group (Table 5).
- **Periapical Lesion Size:**
- The mean difference in the area of periapical lesions at baseline was not statistically significant for any group.
- Significant reductions in lesion size were observed from baseline to 1 month, 3 months, and 6 months for all groups ($p < 0.05$) (Table 6).
- Comparisons between **Tubli-Seal** and **Nineteen NT Apexseal** and **AH Plus** showed non-significant differences at baseline but significant differences at 1, 3, and 6 months (Table 7).
- At 3 months, **Nineteen NT Apexseal** and **AH Plus** showed comparable effects on periapical healing.
- At 6 months, **AH Plus** and **Maarc Ceraseal B Sealer** exhibited similar effects, though the differences were statistically non-significant.
- **Maarc Ceraseal B Sealer** demonstrated the highest periapical healing rate at 6 months, followed by **AH Plus, Nineteen NT Apexseal**, and **Tubli-Seal** (Table 7). **AH Plus** and **Maarc Ceraseal B Sealer** showed comparable healing effects at 6 months.

DISCUSSION

The primary aim of root canal treatment (RCT) is to ensure thorough cleaning and shaping of the root canal system while effectively managing pain. Pain perception during this procedure is subjective and influenced by various factors, making self-evaluation crucial for pain assessment. Apical periodontitis disrupts bone homeostasis,

leading to increased bone resorption facilitated by osteoclasts, osteoblasts, and cementoblasts involved in bone formation and resorption.

In this study, the null hypothesis was rejected, revealing significant differences in periapical healing rates and postoperative pain levels associated with various endodontic sealers. Periodontal ligament fibroblasts are vital for synthesizing collagen fibers that help repair and regenerate periodontal structures, aiding in periapical healing.

Postoperative pain following RCT ranges from 1.9% to 48%, usually decreasing over time due to the periapical inflammatory response. Factors contributing to this pain can be mechanical, chemical, or microbial in nature. The subjective and variable nature of pain makes it difficult to quantify using standard methods, such as numerical, verbal, or visual analogue scales.

Local inflammation, particularly from extruded sealers into peri-radicular regions, can exacerbate postoperative pain and complicate healing. The composition of sealers significantly impacts the severity of these inflammatory responses, with certain sealers generating high levels of reactive oxygen species when in contact with pulpal tissues. Therefore, avoiding direct contact of sealers with periapical tissues is vital to minimize inflammation.

Endodontic sealers, which complement solid or semisolid obturating materials, play a crucial role in securing the root canal system. An ideal sealer should provide excellent sealing ability and have antibacterial properties to combat endodontic infections, prevent nutrient leakage, and reduce the risk of reinfection while promoting healing.

Historically, zinc oxide-eugenol (ZOE) sealers have been used for their antimicrobial properties, followed by calcium hydroxide-based sealers which promote tissue regeneration. Contemporary epoxy resin-based sealers, such as AH Plus, are noted for their superior sealing abilities and chemical bonding.

The present study examined three types of commonly used endodontic sealers—ZOE (Tubli-Seal), calcium hydroxide-based (Nineteen NT Apex Seal), and epoxy-resin-based (AH Plus)—to assess their impact on postoperative pain. Tubli-Seal, while renowned for its cytotoxicity and irritation potential, showed lower microleakage in certain studies compared to other sealers. Calcium hydroxide sealers are effective but have limitations, such as easier dissolution, while AH Plus exhibits high sealing capacity but can release toxic unpolymerized residues.

Bioceramic sealers also present advantages such as biocompatibility and bioactivity. The study found that Maarc CeraSeal B, an MTA-based bioceramic sealer, showed superior periapical healing compared to others, attributed to its bioactive properties and ability to promote hydroxyapatite formation.

Consistent with findings by Pak and White, the prevalence of postoperative pain peaked at 24-48 hours post-treatment and gradually diminished over the next week. Tubli-Seal was linked to the highest postoperative pain, potentially due to its higher cytotoxicity, whereas Maarc CeraSeal B exhibited biocompatibility and less tissue toxicity.

Despite the reliance on traditional radiography, the study deployed a grid-based measurement technique to objectively assess periapical healing, showing significant improvement at the 3-month mark post-treatment. While the Verbal Rating Scale (VRS) remains effective for pain measurement, its subjectivity calls for robust methodologies like a split-mouth design in future studies to better control variability and enhance reliability in pain assessments.

CONCLUSION

In summary, within the limitations of this study, the following key findings were observed:

1. **Postoperative Pain**: The use of Maarc Cera Seal B sealer resulted in less postoperative pain compared to AH Plus, Nineteen NT Apexseal, and Tubli-Seal. Pain scores for all patients were reduced to zero by 7 days, indicating a gradual decrease in pain over time.
2. **Periapical Healing**: Maarc Cera Seal B sealer demonstrated superior periapical healing compared to the other sealers (AH Plus, Nineteen NT Apexseal, and Tubli-Seal) at both 3 and 6 months. The study found that a 3-month period was sufficient to observe significant periapical healing across all groups.
3. **Future Research**: Further studies are recommended to evaluate a broader range of endodontic sealers to confirm and expand upon the results obtained in this study. Such research could help in establishing a more comprehensive understanding of the effects of different sealers on postoperative pain and periapical healing.

Overall, Maarc Cera Seal B sealer appears to be a promising option for reducing postoperative pain and enhancing periapical healing in root canal treatments, but additional research is needed to validate these findings with a wider array of sealers.

REFERENCES

1. Khandelwal A, Janani K, Teja K, Jose J, Battineni G, Riccitiello F, Valletta A, Palanivelu A, Spagnuolo G. Periapical Healing following Root Canal Treatment Using Different Endodontic Sealers: A Systematic Review. Biomed Res Int. 2022 Jul 8;2022:3569281. doi: 10.1155/2022/3569281. PMID: 35845966; PMCID: PMC9286882.
2. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: systematic review of the literature -- Part 2. Influence of clinical factors. Int Endod J. 2008 Jan;41(1):6-31. doi: 10.1111/j.1365-2591.2007.01323.x. Epub 2007 Oct 10. PMID: 17931388.
3. Lee JK, Kwak SW, Ha JH, Lee W, Kim HC. Physicochemical Properties of Epoxy Resin-Based and Bioceramic-Based Root Canal Sealers. Bioinorg Chem Appl. 2017;2017:2582849. doi: 10.1155/2017/2582849. Epub 2017 Jan 22. PMID: 28210204; PMCID: PMC5292198.
4. Ferreira NS, Gollo EKF, Boscato N, Arias A, Silva EJNLD. Postoperative pain after root canal filling with different endodontic sealers: a randomized clinical trial. Braz Oral Res. 2020;34:e069. doi: 10.1590/1807-3107bor-2020.vol34.0069. Epub 2020 Jul 15. PMID: 32696911.
5. Karamifar K, Tondari A, Saghiri MA. Endodontic Periapical Lesion: An Overview on the Etiology, Diagnosis and Current Treatment Modalities. Eur Endod J. 2020 Jul 14;5(2):54-67. doi: 10.14744/eej.2020.42714. PMID: 32766513; PMCID: PMC7398993.
6. Ricucci D, Langeland K. Apical limit of root canal instrumentation and obturation, part 2. A histological study. Int Endod J. 1998 Nov;31(6):394-409. https://doi.org/10.1046/j.1365-2591.1998.00183.x » https://doi.org/10.1046/j.1365- 2591.1998.00183.x
7. Ruparel NB, Ruparel SB, Chen PB, Ishikawa B, Diogenes A. Direct effect of endodontic sealers on trigeminal neuronal activity. J Endod. 2014 May;40(5):683-7. https://doi.org/10.1016/j.joen.2014.01.030
8. Ates AA, Dumani A, Yoldas O, Unal I. Post-obturation pain following the use of carrier-based system with AH Plus or iRoot SP sealers: a randomized controlled clinical trial. Clin Oral Investig. 2019 Jul;23(7):3053-61. https://doi.org/10.1007/s00784-018- 2721-6
9. Graunaite I, Skucaite N, Lodiene G, Agentiene I, Machiulskiene V. Effect of resin- based and bioceramic root canal sealers on postoperative pain: a split-mouth randomized controlled trial. J Endod. 2018 May;44(5):689-93. https://doi.org/10.1016/j.joen.2018.02.010
10. Shashirekha G, Jena A, Pattanaik S, Rath J. Assessment of pain and dissolution of apically extruded sealers and their effect on the periradicular tissues. J Conserv Dent. 2018 Sep-Oct;21(5):546-50. https://doi.org/10.4103/JCD.JCD_224_18
11. Gomes-Filho J. E., Watanabe S., Cintra L. T., et al. Effect of MTA-based sealer on the healing of periapical lesions. *Journal of Applied Oral Science* . 2013;21(3):235–242. doi: 10.1590/1679-775720130089. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
12. Leonardo M. R., Silva L. A., Utrilla L. S., Assed S., Ether S. S. Calcium hydroxide root canal sealers—histopathologic evaluation of apical and peripaical repair after endodontic treatment. *Journal of Endodontics* . 1997;23:428–432. doi: 10.1016/s0099- 2399(97)80296-8. [PubMed] [CrossRef] [Google Scholar]
13. Ahmed T. I., Hossain M. M., Susta F. H. An uneventful effect of accidental extrusion of excess sealer on periradicular healing: two case reports. *Update Dental College Journal* . 2016;5(2):52–56. doi: 10.3329/updcj.v5i2.27276. [CrossRef] [Google Scholar]
14. Holland R., Gomes Filho J. E., Cintra L. T., Queiroz Í. O., Estrela C. Factors affecting the periapical healing process of endodontically treated teeth. *Journal of Applied Oral Science* . 2017;25(5):465–476. doi: 10.1590/1678-7757-2016-0464. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
15. AlRahabi MK. Predictors, prevention, and management of postoperative pain associated with nonsurgical root canal treatment: A systematic review. *J Taibah Univ Med Sci.* 2017;12:376–84. [PMC free article] [PubMed] [Google Scholar]